

Embodiment and Human Reasoning

IISREEC, International interdisciplinary seminar on new robotics, evolution and embodied cognition

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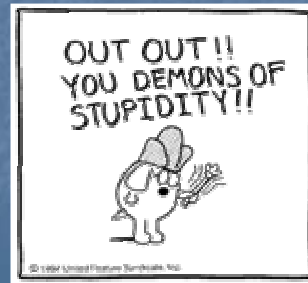


Contributors

- Andy Bulka
- Yanna Rider
- Geoff Cumming
- Melanie Bissett
- Angela Donohue

Questions:

- How do we reason?
 - "in our heads"?
- How can we reason better?
 - Education
 - Real world performance



Reasoning

- General "real world" informal reasoning and argument
- High level cognition



What is involved in reasoning?

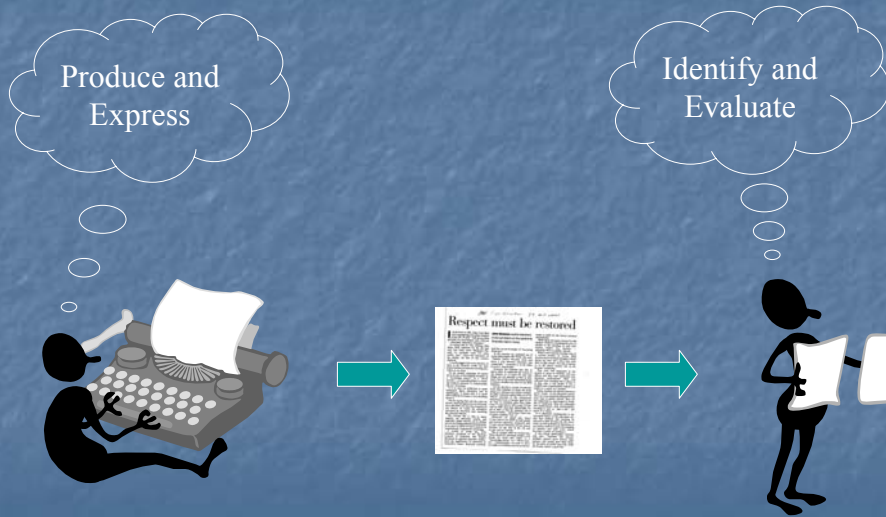
Arguments: abstract, complex structures of inferentially-related claims

- Construct
- Comprehend
- Modify
- Evaluate

Standard Reasoning Practices

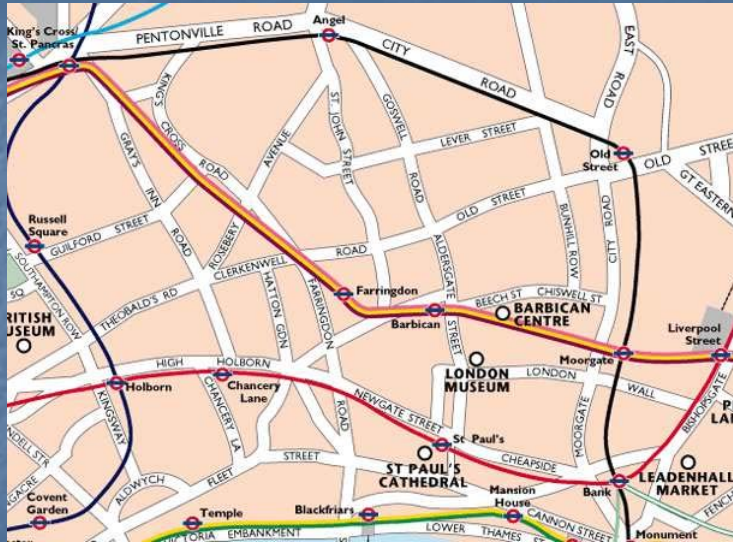


Communicating Reasoning



Pentonville Road runs from east to west, then turns into City Road, which comes to a T-junction where East Road meet Moorgate City Road. Running roughly south from Pentonville Road is first Gray's Inn Road and then King's Cross Road, which turns into Farringdon Road after the intersection with Clerkenwell Road. Where Pentonville Road turns into City Road, St. John's Street runs south. As you go along City Road, you come to Goswell Road (which turns into Aldersgate Street) and Bunhill Row running south. As you go down Gray's Inn Road, the first intersection is with Guildford Street, which continues to a T-junction with King's Cross Road. The next intersection, as you continue down Gray's Inn Road, is with Theobald's Rd, which at that point turns into Clerkenwell Road, though you could veer of NE along Rosebery Avenue which crosses King's Cross Road before it joins St. John's Street near the junction of Pentonville Road and City road. Gray's Inn Road terminates at High Holborn, a major E-W road which, as you go east, turns into Newgate Street and then Cheapside. St. Paul's Cathedral is between Newgate Street and Fleet Street, which runs roughly parallel to Newgate. Southampton Row goes south intersecting with Guildford Street, Theobald's Road and High Holborn, where it becomes Kingsway, which continues south to a T-junction with the curve of Aldwych, which begins and ends on Fleet Street. From Roseberry Road you can head east along Lever Street, which crosses St. John's Street and Goswell Road before finishing at Bunhill Row where it meets City Road. Heading south down St. John's Road, you cross Lever Street and then Clerkenwell Road. Goswell Road also crosses Lever Street and Clerkenwell Road (which at that point becomes Old Street). Goswell Road becomes Aldersgate Street. Hatton Garden goes between Clerkenwell Road and High Holborn. Streets running south from High Holborn are Kingsway, Chancery Lane and Farringdon Road. Chancery Lane is a short street finishing at Fleet Street. Fleet Street ends at a large intersection just east of St. Paul's. Aldersgate Street continues past London Museum (which is at the corner of Aldersgate and London Wall) down to Newgate Street. Beech Street runs E from Aldersgate, turning into Chiswell Street before it meets City Road. East Road runs south, past the intersection of City Road, over Old Street and London Wall, where it becomes Moorgate Street.

How do you get from St. Paul's Cathedral to London Museum?

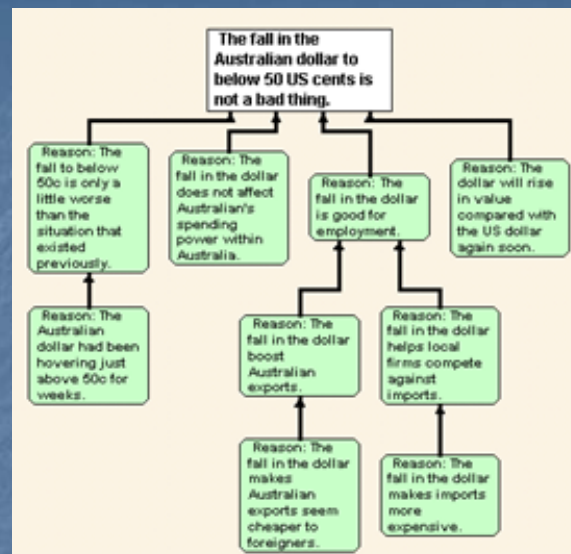
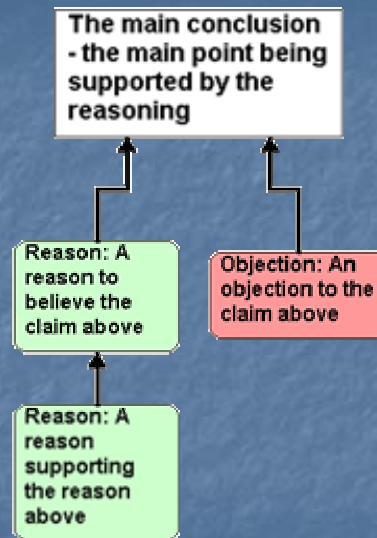


Panic if you like, but it's only a number, by Ross Gittins

If you want to believe that the dollar's fall below US\$50¢ spells disaster for the economy, go right ahead. If you can convince yourself there's a world of difference between an exchange rate that's a fraction above or a fraction below a nice round number like 50, go for it. Let it all hang out - the whingeing and wailing, the sackcloth and ashes, the name-calling and blame-laying, the talk about going down the gurgler. Don't hold back. We live in an era when every type of news has become grist to the mill of daily entertainment - the unending search for something talkback radio can be all shook up about - and the economy must take its turn. Indeed, the economy is well suited to the role. Because we're all part of it, we're in no doubt that our opinions on it are expert. Do you need a university degree to know whether a fall in the dollar is a good or bad thing? Of course not. Any fool knows that down is bad and up is good. But though we're all part of the economy, we feel alienated from it. The exchange rate, for instance, is not something that belongs to us, but rather to our much despised politicians. So when we pour scorn on our nation's currency - when we repeat the tired jokes about the Pacific Peso or Monopoly money - we're not being disloyal or self-flagellating, we're just taking another knock at our political masters. There is an air of unreality about all our carry-on over the dollar - which is why I'm not disposed to take it seriously. So if you enjoy a good panic - feel free. Then, once you've had your fun, you may be disposed to stop reacting on instinct and start using your grey matter. Point One: the dollar has been hovering above US\$50¢ for weeks so, if that's a terrible thing, its dip below 50 is only a little worse. Point Two: why, exactly, is a low dollar such a terrible thing? Why should you care how many US cents one Australian dollar buys? If you were planning to sell up here and emigrate to America, it would certainly be bad news. But if you live in Australia, earn your income in Australia and spend it in Australia, you're little affected. One Australian dollar still gets you 100 Australian cents - just as it did yesterday. True, if you were planning a holiday overseas or intending to buy a flash imported car you wouldn't be too happy. But why should the rest of us lose sleep over that? You'll just have to slum it in a Commodore at Noosa. Point Three: the disadvantage of a fall in the dollar is that it raises the price of imported goods; the advantage is that it makes Australia's exports seem cheaper to foreigners. So, though it may add to inflation, it also boosts the production of Australian exporters and local firms that compete against imports - which is good for employment. Point Four: whether a fall in the dollar is good or bad, history tells us it never lasts. Before long, it goes back up. So if you want to panic, do it now, while you can.

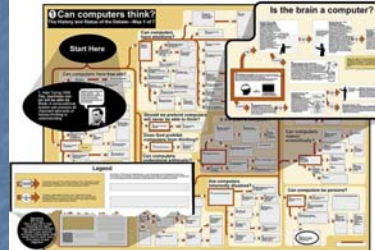
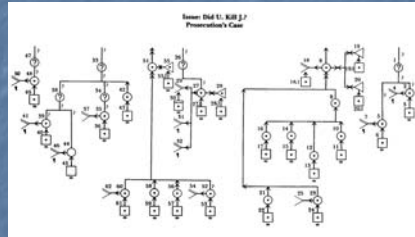
What is the main point being argued for?
How many primary reasons for that main point?

How to read a
Reason!-style
argument map



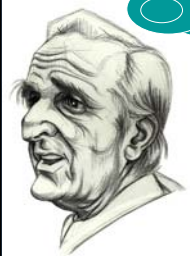
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Argument Mapping

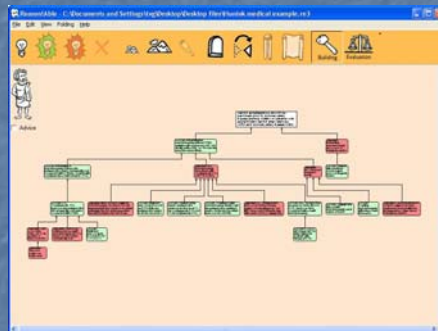


Englebart, 1962: Computer-Supported Argument Mapping

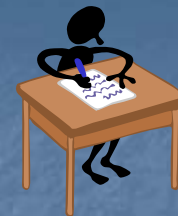
- Enter statements using voice recognition
- Display on a monitor
- Manipulate using a light pen
- Edit, delete, group statements
- Graphically display sub sentential structure
- Link statements to display argumentative structure
- Selectively display parts of the argument
- Zoom; zones of variable magnification
- Append notes, etc.



Reason!Able, 2000



Evaluation

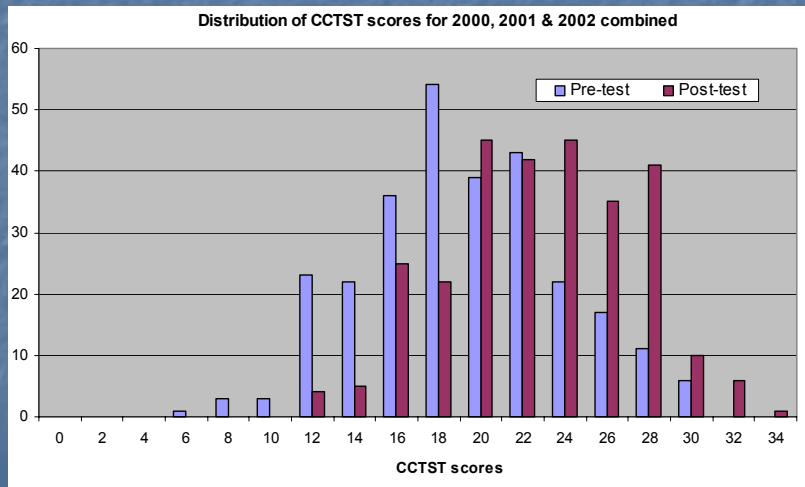


- Pre and post testing
- Objective (multi-choice) and written tests
- Comparison groups

Table 1: Reason Project Pre/Post Studies, 1999-2002

St	Year	Sample	Intervention	Test	n	Pre-Test Mean (SD)	Post-Test Mean (SD)	Effect Size (Cohen's d)	Effect Size (Cohen's f)	Mean Change (SD)	t	p
1	1999	2000	Reason!Able	Reason!Able	48	62.85 (20.76)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
2	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
3a	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
3b	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
4a	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
4b	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
5a	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
5b	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
6a	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
6b	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
7a	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
7b	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
8a	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04
8b	1999	2000	Reason!Able	Reason!Able	50	61.50 (19.80)	64.52 (21.76)	0.07	0.20	1.67	15	0.04

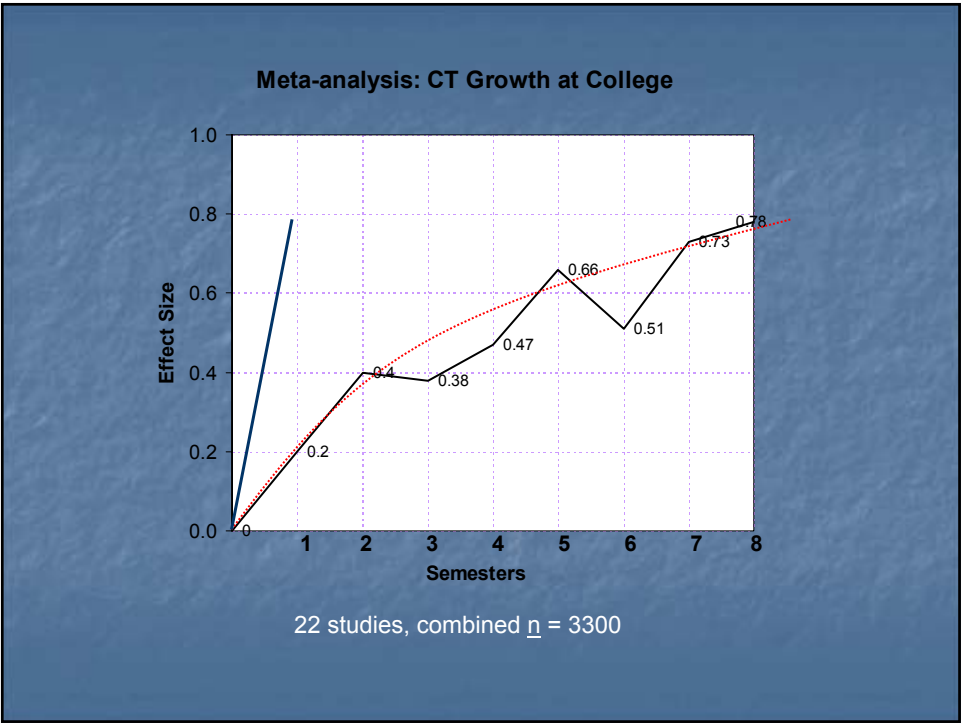
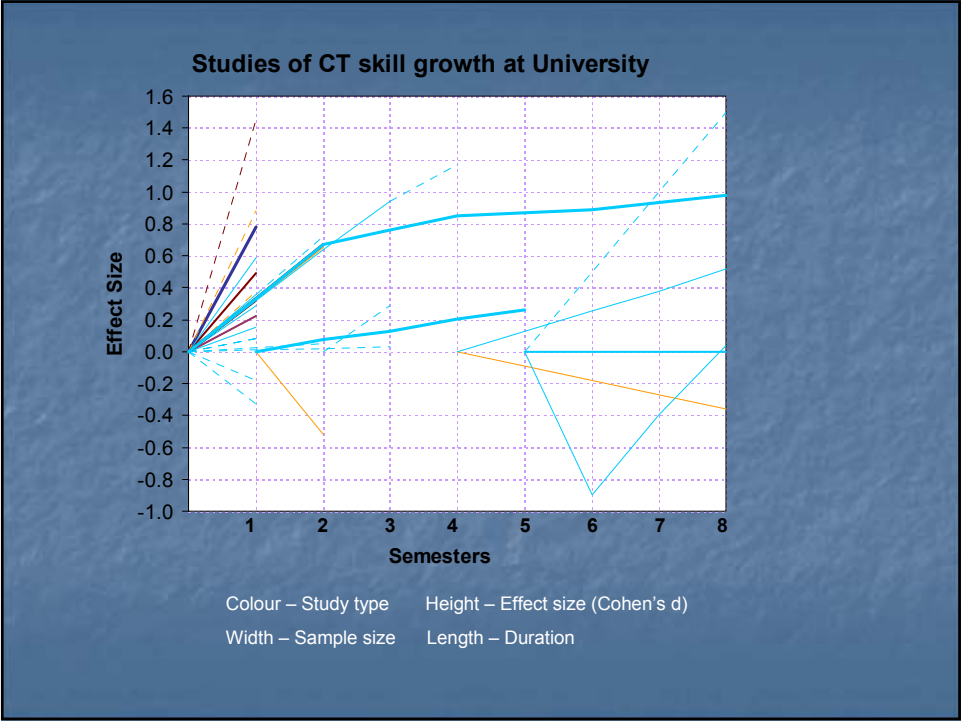
One Semester Gain, Reason! Approach



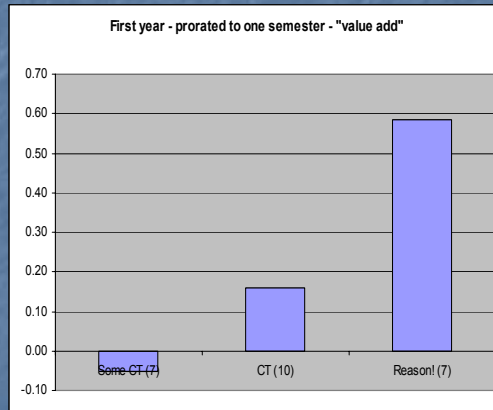
Systematic Review of Empirical Literature



- Hundreds of studies
- Many different designs
- Many different measures
- Many different contexts and periods
- Inadequate statistics



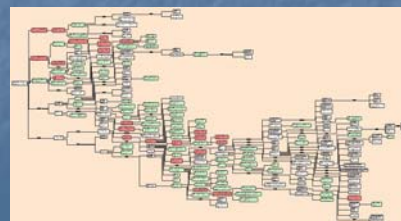
Meta-analysis – “value add”



- 4 times as effective as traditional instruction
- Gross gain equivalent to 4 years college
- Approx. = 12 point IQ gain

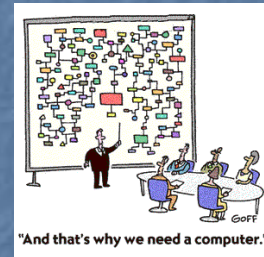
CSAM in Professional Contexts

- Group deliberation
- Critical review of e.g. reports
- Communicating complex arguments



Professional CSAM: Benefits

- Greater comprehension
- More explicitness and depth
- Shared understanding
- Targeted contributions
- Depersonalization of disputes
- Better judgments (?)



More "Embodied" Reasoning

Perception

- Shape
- Colour
- Line
- Position in space

Action

- Visual orienting & scanning
- Creating
- Moving
- Combining
- Tearing apart

Social

- Common "mental" representation
- Targeted contributions



Minority Report - 2054



Near Future of CSAM

- Better software
- "Intelligence"
- Immersive and semi-immersive environments
- More immediate control (data glove, gaze control)



CSAM - 2054

- Internal
- Thought control
- Artificial intelligence
- Shared representations



How do we reason?

- Skillful, embodied coping with external representations and tools
- Involves mapping abstract logical structures and manipulations onto our cognitive mechanisms for negotiating space
- Partial, derivative and hard-won ability to internally simulate such coping
- New technologies are substantially enhancing reasoning ability (and changing our forms of coping)
- Long-term: technological “internalization” of these representations and tools

